

REMARKS

In view of the foregoing amendments and following remarks, reevaluation and further processing of the application is requested. Prior to amendment herewith, Claims 1, 2, 7-15 and 20 were pending in the application. By amendment herewith, Claim 1 has been amended, Claims 2, 7-15 and 20 have been cancelled, and new Claims 21-29 have been added. Thus, Claims 1 and 21-29 are now pending.

Background and Amendment of Claim 1

The instant application is directed to methods and systems for reducing energy consumption in aluminum electrolysis cells. To demonstrate the utility, novelty and non-obviousness of the invention, Applicant provides the following background.

Aluminum production via electrolysis generally comprises passing an electric current through a molten cryolite bath. This cryolite bath is covered by a solid crust that is punctured regularly when molten aluminum is tapped from the cell. Puncturing of the solid crust results in a crust hole. Crust holes inhibit efficient cell operation. For example, crust holes result in higher aluminum fluoride emissions from the pot, thereby increasing the load on the pot scrubber. Furthermore, open crust holes in a pot line increase variations in the bath ratio, resulting in poorer cell performance. Hence, open crust holes are detrimental to efficient aluminum production. (See generally, Paras. 0002-0004 of the instant application).

In many conventional aluminum production facilities, an aluminum potline methodology is employed, wherein a series of aluminum electrolysis cells are lined up (e.g., side-by-side or end-to-end) in one or more rows down the center of the potroom. In many configurations, between 100 and 240 individual aluminum electrolysis cells may make up a single potline. (See generally, Primary Aluminum Industry: Technical Support Document for Proposed MCAT Standards, EPA, Office of Air Quality Planning and Standards, Emission Standards Division, pp. 2-1 through 2-6, 1996)

To collect gases emitted during operation of the aluminum electrolysis cell, hooding is used on each cell. The hooding does not totally enclose the cell at all times because the cell must be periodically opened, generally via the hooding, to add alumina, replace anodes, and to correct anode effects (e.g., holes in the crust). In some instances, the aluminum

hooding is a system of individual side shields that can be opened to expose only that section of the cell. In these instances:

"a superstructure supports the anode bus bars . . . Hoods are formed using curved metal side shields that extend from the outside edges of the pot sides to this super structure. At each end of the pot, the space between the pot and the hopper is closed and fitted with a door. Usually, there is one side shield per anode, and the side shield may be notched to fit tightly around the anode hanger. The shields and doors are removed and replaced manually. Together the superstructure, side shields, and end pieces form an enclosure. The fumes escaping from the pots are captured by enclosing the whole pot bath area and by sealing the pot enclosure to the maximum extent possible. . . . *The capture efficiency is improved (and secondary emissions are reduced) by minimizing the frequency, number, and duration of side shield and door removals (e.g., for removing anodes or correcting anode effects).* (emphasis added)

(See generally, Primary Aluminum Industry: Technical Support Document for Proposed MCAT Standards, EPA, Office of Air Quality Planning and Standards, Emission Standards Division, pp. 3-1 through 3-5, 1996)

It is convention practice to have operators manually open, several times a day, the hooding of tens, or even hundreds, of aluminum electrolysis cells to inspect those cells for, among other things, crust holes. Significant labor costs may be incurred due to operators unnecessarily opening hoods. Furthermore, unnecessarily opening hoods may degraded cell performance. Thus, one objective of the present invention is to provide a process for controlling inspections and repairs for crust holes in aluminum production cells so that such inspections and repairs are performed where and as needed. (Para. 0008 of the instant application).

In furtherance of this and other objectives, the present invention was contemplated, wherein an infrared sensor is mounted to a moveable device, and often preexisting device within the manufacturing facility (e.g., a crane), that regularly travels adjacent to the cells of the potline. The infrared scanner scans the hooding of the aluminum electrolysis cells as the moveable device travels adjacent the potline, capturing thermal images of the hooding during its travels. The infrared scanner sends these thermal images to a data processor, which extrapolates the actual temperature of the outer surface of the hooding. Since a target hood temperature is known, it can be determined whether a particular cell requires inspection via

comparison of actual hooding temperatures to the target hood temperature. Cells exhibiting an actual hood temperature deviating from a target hood temperature are inspected for crust holes. Hence, hooding is opened and the crusts are inspected on a less frequent basis, thereby reducing labor costs, assisting in maintaining the heat balance of the cell, increasing cell efficiency and reducing energy consumption and emissions. (See generally, Para. 0015, 0017-0019, 0021, 0030-0031 of the instant application).

To better present the invention, Applicant has amended Claim 1. Amended Claim 1 recites a method for determining whether to inspect a crust of an aluminum electrolysis cell for a crust hole by:

- (a) operating an aluminum electrolysis cell having hooding connected therewith;
- (b) confining fumes evolved from the aluminum electrolysis cell via the hooding;
- (c) moving a crane adjacent to the aluminum electrolysis cell, the crane having an infrared sensor mounted thereto;
- (d) sensing infrared radiation on the outer surface of the hooding with the infrared sensor to obtain a thermal image of the hooding;
- (e) sending the thermal image to a data processor;
- (f) extrapolating an actual temperature of the hooding from the thermal image of the hooding via the data processor; and
- (g) when the actual temperature varies from a target hooding temperature by more than a preselected limit, inspecting the crust of the aluminum electrolysis cell for a crust hole.

Support for the various limitations of amended Claim 1 are provided in below Table 1.

Table 1 - Support for Amended Claim 1

| Limitation | Support |
|---|--|
| (a) operating an aluminum electrolysis cell having hooding connected therewith; | Figure 1 (cell - 1; hooding-21); Paras. 0001-0002, 0030 |
| (b) confining fumes evolved from the aluminum electrolysis cell via the hooding; | Para. 0015, 0030 |
| (c) moving a crane adjacent to the aluminum electrolysis cell, the crane having an infrared sensor mounted thereto; | Figure 1 (crane - 27; cell - 1; infrared sensor - 23); Paras. 0017, 0018, 0030 |

| Limitation | Support |
|---|---|
| (d) sensing infrared radiation on the outer surface of the hooding with the infrared sensor to obtain a thermal image of the hooding; | Figure 1 (dotted line); Paras. 0017, 0018, 0030, original claim 1 |
| (e) sending the thermal image to a data processor; | Para. 0030 |
| (f) extrapolating an actual temperature of the hooding from the thermal image of the hooding via the data processor; and | Para. 0030 |
| (g) when the actual temperature varies from a target hooding temperature by more than a preselected limit, inspecting the crust of the aluminum electrolysis cell for a crust hole. | Para. 0019, 0031, original claim 1 |

The Cited Art Does Not Disclose, Teach or Suggest The Invention Defined By Claim 1

In the prior office action, the Examiner rejected all pending claims under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 4,668,350 to Desclaux et al. ("Desclaux") in combination with U.S. Patent No. 6,440,294 to Cotton ("Cotton") and U.S. Patent Publication No. 2002/0146057 to Barron, Jr. et al. ("Barron, Jr."). Applicant respectfully submits that none of the cited art discloses, teaches or suggests methods of determining whether to inspect an aluminum electrolysis cell for a crust hole, as provided by amended Claim 1.

Desclaux discloses methods for controlling the rate of aluminum fluoride addition to an aluminum electrolysis cell (Abstract). Desclaux does not disclose, teach or suggest, methods for determining whether to inspect an aluminum electrolysis cell for a crust hole. In particular to Claim 1, Desclaux does not disclose, at a minimum, utilizing an infrared sensor attached to a crane, moving the crane adjacent to an aluminum electrolysis cell, sensing infrared radiation on the outer surface of the hooding of the aluminum electrolysis cell to obtain a thermal image, sending the thermal image to a data processor, extrapolating an actual temperature of the hooding via the thermal image and data processor, and/or inspecting the crust of the aluminum electrolysis cell for a crust hole when the actual temperature varies from a target hooding temperature by more than a preselected limit.

Cotton discloses processes for repairing crust holes in aluminum electrolysis cells (Abstract). Cotton does not disclose, teach or suggest methods for determining whether to inspect an aluminum electrolysis cell for a crust hole. In particular to Claim 1, Cotton does not disclose, at a minimum, utilizing an infrared sensor attached to a crane, moving the crane

adjacent to an aluminum electrolysis cell, sensing infrared radiation on the outer surface of the hooding of the aluminum electrolysis cell to obtain a thermal image, sending the thermal image to a data processor, extrapolating an actual temperature of the hooding via the thermal image and data processor, and/or inspecting the crust of the aluminum electrolysis cell for a crust hole when the actual temperature varies from a target hooding temperature by more than a preselected limit.

Barron, Jr. discloses methods for non-contact temperature sensing. Barron, Jr. does not disclose, teach or suggest methods for determining whether to inspect an aluminum electrolysis cell for a crust hole. In particular to Claim 1, Barron, Jr. does not disclose, at a minimum, operating an aluminum electrolysis cell having hooding attached thereto, confining fumes evolved from the aluminum electrolysis cell via the hooding, moving a crane adjacent to the aluminum electrolysis cell, the crane having an infrared sensor mounted thereto, sensing infrared radiation *on the outer surface of the hooding*, extrapolating an actual temperature *of the hooding* from the thermal image of the hooding via the data processor, and/or inspecting the crust of the aluminum electrolysis cell for a crust hole when the actual temperature varies from a target hooding temperature by more than a preselected limit.

In view of the foregoing, Applicant respectfully submits that Claim 1 is novel and non-obvious over the art of record.

Dependent Claims 21-25

Applicant has added new claims 21-25, all of which depend, directly or indirectly, from Claim 1. Support for these dependent claims is provided in below Table 2.

Table 2 - Support for Dependent Claims 21-25

| Dependent Claim | Limitation | Support |
|------------------------|--|------------------|
| 21 | wherein the sending the thermal image step comprises transmitting the thermal image to a hand-held computer. | Para. 30 |
| 22 | wherein the transmitting the thermal image step comprises a wireless transmission. | Para. 30 |
| 23 | estimating the open area in the crust of the cell via the thermal image. | Para. 0018 |
| 24 | predicting the daily amount of AlF_3 addition for the aluminum electrolysis cell based on the open area in the crust. | Para. 0018 |
| 25 | completing steps (a) - (h) for each of a plurality of aluminum electrolysis cells. | Original claim 9 |

Applicant respectfully submits that none of the cited art discloses, teaches or suggests the limitations of these claims.

New Claims 26-29

Applicant has added new Independent Claim 26 and Dependent Claims 27-29. Independent Claim 26 recites a system for determining whether to inspect an aluminum electrolysis cell for a crust hole. The system includes:

- an aluminum electrolysis cell for producing aluminum metal;
- hooding for confining fumes evolved from the aluminum electrolysis cell;
- a crane operable to travel adjacent the aluminum electrolysis cell;
- an infrared sensor mounted to the crane, wherein the infrared sensor scans the hooding to obtain a thermal image of the hooding; and
- a data processor for extrapolating the actual temperature of the hooding based on the thermal image of the hood and for comparing the actual temperature to a target hood temperature, wherein the infrared sensor transmits the thermal image to the data processor, and wherein when the actual temperature of the hooding varies from the target temperature an indication is provided to inspect the crust of the aluminum electrolysis cell for a crust hole.

Support for the various limitations of Independent Claim 26 are provided in below Table 3.

Table 3 - Support for Independent Claim 26

| Limitation | Support |
|--|--|
| an aluminum electrolysis cell for producing aluminum metal; | Figure 1 (Cell - 1); Paras. 0011-0012, 0024 |
| hooding for confining fumes evolved from the aluminum electrolysis cell; | Figure 1 (Hooding - 21); Paras. 0018, 0030 |
| a crane operable to travel adjacent the aluminum electrolysis cell; | Figure 1 (Crane - 27); Para. 0030 |
| an infrared sensor mounted to the crane, wherein the infrared sensor scans the hooding to obtain a thermal image of the hooding; and | Figure 1 (Sensor - 23); Paras. 0017, 0018, 0030 |
| a data processor for extrapolating the actual temperature of the hooding based on the thermal image of the hood and for comparing the actual temperature to a target hood temperature, wherein the infrared sensor transmits the thermal image to the data processor, and wherein when the actual temperature of the hooding varies from the target temperature an indication is provided to inspect the crust of the aluminum electrolysis cell for a crust hole. | Figure 1 (Processor - 30); Paras. 0018, 0019, 0030, 0031 |

For many of the same reasons provided above with respect to Claim 1, Applicant respectfully submits that Claim 26 is novel and non-obvious. For example, none of Desclaux, Cotton, or Barron Jr. disclose, at a minimum, a crane for traveling adjacent to the aluminum electrolysis cell, an infrared sensor mounted to the crane, or a data processor that receives thermal images from the infrared sensor and extrapolates the actual temperature of the cell's hooding based on the thermal image of the hooding.

Dependent claims 27-29 depend, directly or indirectly, from Independent Claim 26. Support for these dependent claims is provided in below Table 4.

Table 4 - Support for Dependent Claims 27-29

| Dependent Claim | Limitation | Support |
|------------------------|--|----------------|
| 27 | wherein the data processor comprises a hand-held computer. | Para. 0030 |
| 28 | wherein the hand-held computer is a personal digital assistant. | Para. 0030 |
| 29 | wherein the infrared sensor is operable to transmit thermal image to the data processor via a wireless transmission. | Para. 0030 |

Applicant respectfully submits that none of the cited art discloses, teaches or suggests the limitations of these claims.

Information Disclosure Statement

Applicant also includes with this Amendment and Request for Continued Examination one or more additional documents for consideration as provided on the enclosed PTO Form 1449. In accordance with 37 C.F.R. §1.98(a)(2), copies of non-U.S. Patent documents listed therein are included herewith, unless previously submitted. No representation is made that a reference is "prior art" within the meaning of 35 U.S.C. §§ 102 and 103, and Applicant reserves the right, pursuant to 37 C.F.R. § 1.131, or otherwise, to establish that the reference(s) is/are not "prior art." Moreover, Applicant does not represent that a reference has been thoroughly reviewed or that any relevance of any portion of a reference is intended. Pursuant to 37 C.F.R. 1.97(b)(4), it is not believed that any fees are due in connection with this information disclosure statement.

Consideration of the listed items is respectfully requested. Pursuant to the provisions of M.P.E.P. 609, it is requested that the Examiner return a copy of the attached Form 1449, marked as being considered and initialed by the Examiner, to the undersigned with the next official communication.

Conclusion

In light of the above amendments and remarks, Applicant respectfully submits that all pending claims are in condition for allowance, and such action is respectfully requested. If the Examiner believes that any of the pending claims presented herein are not allowable,

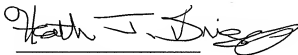
Applicant respectfully requests that the Examiner contact the undersigned to schedule a telephonic interview.

It is not believed that any additional fees are due in connection with this response. However, any necessary fees may be charged to Deposit Account No. 01-1000.

Respectfully submitted,

GREENBERG TRAURIG, LLP

Date: March 26, 2007

A handwritten signature in dark ink, appearing to read "Heath J. Briggs", written over a horizontal line.

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